DETAILED ACTION

Priority

1. Acknowledgment is made of applicant's claim for foreign priority under 35 U.S.C. 119(a)-(d). The certified copy has been filed in parent Application No. PCT/KR05/00698, filed on 3/11/2005.

Information Disclosure Statement

2. The information disclosure statement (IDS) submitted on 9/6/2006 is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Specification

3. The disclosure is objected to because of the following informalities: At several points of the specification, a “□” is present and in addition the intended character is not apparent. (see for example: page 4, line 16 and page 9, line 24)

Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 8, 11, 14, 17 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 8 recites that the photocatalyst comprise one or more metals, which are selected from the group consisting of “silicide-based metals, *including* Ni, Pt, … PtSi, and NiSi”. Since there appears to be a redundancy in listing both silicide-based metals and listing Ni and Pt as well as listing PtSi and NiSi, it is not clear if metals must be silicide-based metals, or if they must include one of the metals or silicides listed. In addition, the term “including” creates an indefinitely large group to choose from. For purposes of examination, the list of both metals and metal silicides is taken to be the group to be examined.

Claim 11 recites that the oxide-based nanomaterial has a diameter, while claim 1, from which claim 11 depends, does not recite a shape that would require a diameter. In addition, several shapes may feasibly have a diameter, so the shape of the oxide-based nanomaterial by reciting “diameter” is not clearly defined. In addition, a “□” is present and the intended length unit is not easily ascertained.

Claims 14 and 17 recites a coating selected from the group consisting of “MgO, CdO, GaN,...and compounds thereof”. Since the listed species are already considered to be compounds, species that would be considered to be compounds of compounds are not well defined.

Claim Rejections - 35 USC § 102 and 103

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

9. Claims 1 and 2 are rejected under 35 U.S.C. 102(b) as being anticipated by Talpaert, et al. (US 6,465,088).

Talpaert ’088 teaches a substrate with a photocatalytic coating. The photocatalytic properties are from crystallized particles of metal oxides A and B. (claim 1) The crystallized particles are nano-sized, for example from about 5-80nm. (claim 2)

The catalytic oxides may be oxides of metals such as Ti and Zn. (claim 11) The substrate may be glass. (col 1, line 65)

Thus, Talpaert ’088 anticipates a photocatalyst including a matrix, comprising a substrate and an oxide-based nanomaterial.

10. Claims 1-5 and 9-17 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Majumdar, et al. (US 2002/0175408).

Majumdar ‘408 recites a nanowire of a coaxial heterostructure nanowire (COHN) structure. The structure comprises a crystalline core surrounded by a sheath, with a junction formed in between. (para. 71; Fig 2) The heterostructures may comprise materials such as doped or undoped semiconductor materials. Conventional dopants include Al and In. The nanowire and dopant materials can include oxides. The materials are arranged to created desired semiconductor junctions. (para. 76) The diameter of the nanowires created are typically less 200 nm, and preferably between 5-50nm. (para. 81) Examples of core/sheath materials in a COHN structure include combinations like SnO_2 and TiO_2, or GaN and ZnO. However, Majumdar ‘408 states that there is essentially an unlimited number of core/sheath material configurations. (para. 111) A COHN structure may also have a LOHN (longitudinal heterostructure nanowire) score. (Fig. 7) The general approach to making COHN can be used to create nanotubes. The core material may be etched or stripped away to leave a hollow cylinder of the sheath material. The sheath may be made by the materials discussed

earlier. (para. 112) In one example, Majumdar '408 discloses the growth of ZnO nanowires. They are grown on sapphire substrates using a vapor phase transport process. (para. 204) Nearly all of the nanowires grew vertically from the substrate. (para. 206) The end faces of the nanowire was hexagonal and the nanowire was multi-faceted. (para. 207)

Regarding the shape of the oxide-based nanomaterial, the nanowire shape is found to meet the limitation of being in the shape of a nanoneedle, nanorod, or nanotube or being an obvious alternative to these very similar shapes.

Regarding the composition of the nanomaterial, Majumdar '408 discloses ZnO and TiO_2, GaAln and GaN as suitable materials, and also that dopants such as Al or In may be used. The general disclosure of Majumdar '408 fairly teaches or suggests the use of ZnO or TiO_2 as a main component given that they are both mentioned specifically. Majumdar '408 discloses that metal oxides may be either be the core of the sheath material, as well as materials like GaN. Therefore, an oxide-based nanomaterial such as TiO_2 or ZnO coated with a compound such as GaN is fairly taught or suggested by Majumdar '408. An embodiment containing either TiO_2 or ZnO as a main component is also fairly taught in the combination.

Regarding the multiwall or coaxial double wall structure, the instant specification describes the multiwall or coaxial double wall structure as being illustrated by Fig 4, which has a ZnO nanorod as an internal part of a TiO_2 nanorod as an external part. (pg. 9) This structure is substantially identical to the COHN core/sheath structure taught by

Majumdar ‘408. Therefore, a multi-walled or doublewall coaxial structure is found to be fairly taught by Majumdar ‘408.

Majumdar ‘408 does not explicitly teach the composition’s capability as a photocatalyst. However, since the composition and other properties of the product appear to be substantially similar, a photocatalytic property is found to be inherent. In addition, Majumdar ‘408 describes the products made to be useful in fields such as optoelectronics and energy conversion (para. 7) which are related to the field of photocatalysis.

Therefore, claims 1-5 and 9-17 are found to be anticipated, or in the alternative suggested by the Majumdar ‘408. For the product-by-process limitation, the process limitations in these claims are noted. However, when the examiner has found a substantially similar product as in the applied prior art, the burden of proof is shifted to applicant to establish that their product is patentably distinct and not the examiner to show the same process of making. *In re Brown*, 173 USPQ 685 and *In re Fessmann*, 180 USPQ 324.

11. Claims 6-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Majumdar ‘408 as applied to claims 1-5 and 9-17 above, and further in view of Matsuo, et al. (US 2003/0148881) and Talpaert, et al. (US 6,465,088).

Majumdar ‘408 teaches the heterostructure as described above. Regarding depositing metal on an oxide through a sputtering or evaporation process, this is a product-by-process limitation. The deposition process taught by Majumdar ‘408, vapor-phase transport, is found to be a similar process step. Unless it can be shown that a sputtering or thermal or electron beam evaporation method would produce a materially different product than the one made by a vapor-phase transport process, the product claim is found to have been met. Both are created by a vaporizing a metal or metal compound.

However, Majumdar ‘408 does not specifically disclose a metal and oxide creating a heterojunction. Majumdar ‘408 does teach that the segments of a LOHN for example may be made to create desirable semiconductor junctions. (Fig 10, 11)

Matsuo ‘881 describes that relationship between photocatalytic activity and the type of junction. (para. 11)

Talpaert ’088 as discussed above, utilizes crystalline TiO_2 and ZnO on a substrate as a photocatalyst.

Regarding the creation of a metal/oxide heterojunction, it would have been obvious to one of ordinary skill in the art to use suitable means known in the art to create a desirable heterojunction for a photocatalyst. In view of Talpaert ‘088 and Matsuo ‘881 it would have been obvious to one of ordinary skill in the art to use a material as taught in Majumdar ‘408, containing semiconductor junctions and photocatalytic materials, for use as a photocatalyst. One would have further been

motivated to optimize the photocatalytic properties by modifying the semiconductor junction, and creating a metal/oxide heterojunction.

Therefore, claims 6-8 are not found patentable over the prior art.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DIANA J. LIAO whose telephone number is (571)270-3592. The examiner can normally be reached on Monday - Friday 8:00am to 5:30pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stanley Silverman can be reached on 571-272-1358. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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DJL